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RESIDENTIAL WELL WATER SAMPLING PLAN
FOR THE
KEYSTONE SANITATION LANDFILL SITE



Prepared By:
Tracy Flood
Adam M. Selisker

February 10, 1994
Region III Technical Assistance Team
TDD# 9401-30
PCS# 5071

For
Chris Corbett, Remedial Project Manager
Pennsylvania Remedial Branch
U.S. EPA Region III



AR322610

EPA 096348

PROJECT NAME: Keystone Sanitation Landfill
Union Township, Adams County
Pennsylvania

PROJECT REQUESTED BY: Chris Corbett, RPM
U.S. EPA Region III
Pennsylvania Remedial Branch

DATE REQUESTED: February 10, 1994

TECHNICAL DIRECTIVE DOCUMENT: # 9401-30

PROJECT OFFICER: Chris Corbett, RPM
U.S. EPA Region III
Pennsylvania Remedial Branch

REGIONAL ANALYTICAL COORDINATOR: Marian Murphy, TAT Region III

(1) PROJECT DESCRIPTION

A. LOCATION

The Keystone Sanitation Landfill Site is a 40-acre tract of land located along Clouser Road in Union Township, Adams County, Pennsylvania. It is situated approximately 800 feet north of the Pennsylvania - Maryland border.

B. BACKGROUND

The Keystone Sanitation Landfill Site is an inactive, privately owned facility (Keystone Sanitation Company), permitted by Pennsylvania Department of Environmental Resources (PADER) to receive household and municipal wastes and certain types of industrial and construction debris.

According to the Record of Decision (ROD), dated September 30, 1990, the horse shoe-shaped landfill was constructed in 1968 as a renovating base landfill without a liner or leachate treatment or collection system. Depth from the surface to the wastes averages 30 feet. The landfill operated from 1968 to 1990 and is situated on the top of a ridge, with the owner of the landfill residing on the property. There are approximately 38 residents within a one-mile radius of the Keystone Site and approximately 700 residents within a three-mile radius of the Site.

In the ROD, it is estimated that since 1968, 300 to 374 tons per day of waste have been disposed of at the site. In 1974, five monitoring wells were installed by Keystone at the landfill perimeter to monitor groundwater quality.

In 1982, a sample taken by PADER from Keystone monitoring well K1 revealed the

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presence of volatile organic compounds (VOCs). Subsequent testing of the onsite residential well and the nearby Mundorf Spring also revealed the presence of VOCs.

In April 1984, the EPA Field Investigation Team (FIT) performed a site investigation in response to citizen complaints of illegal dumping and groundwater contamination and to assess the Site's eligibility for inclusion on the EPA National Priorities List (NPL). Sample results from PADER and EPA FIT investigations confirmed the presence of low levels of VOC contamination in some residential wells.

In 1984, as a result of the VOC contamination, Keystone installed a spray irrigation system to prevent the migration of contaminants offsite and to remove VOCs from the groundwater. In addition, a leachate collection system was installed on the south side of the landfill along Line Road. The collection system consists of two perforated pipes and a storage tank that was periodically pumped; the leachate was disposed of offsite.

In the spring of 1985, the State of Maryland installed a series of wells at the Maryland border to monitor the potential contaminant migration into Maryland. Low levels of VOC contamination are consistently present in Maryland well No. 2 (MD2), however, no Maryland residential wells have been determined to be contaminated as a result of the landfill.

In July 1987, the Keystone Site was placed on the NPL. Also in July 1987, the Potentially Responsible Parties (PRPs) were asked to perform the Remedial Investigation (RI) and Feasibility Study (FS) for the site. Negotiations failed to obtain cooperation from the PRPs to do the RI/FS, and EPA assigned the RI/FS tasks to REMV, a federal government contractor. RI/FS field activities began in the spring of 1989 and were completed in the winter of 1990. The objectives of the RI were to determine the nature and extent of hazardous substances, pollutants or contaminants on the site and to determine their impact on public health, welfare and the environment. The purpose of the FS was to develop a range of cost-effective remedial alternatives. The RI/FS was finalized on July 20, 1990.

In April 1993, On-Scene Coordinator (OSC) Jerry Heston (now Senior RPM Heston) tasked members of Roy F. Weston's Technical Assistance Team (TAT) to perform residential well and leachate sampling in the area around the Keystone Landfill. A total of 36 residential well samples and two (2) leachate samples were collected. Results indicated that elevated levels of VOCs were present in some areas throughout the Site.

In August 1993, after the review of the April 1993 analytical results, EPA Toxicologist Jennifer Hubbard identified certain target compounds in some of the residential wells that should be resampled for confirmation of possible contamination.

During the week of October 18, 1993, TAT continued efforts to target specific areas and compounds that may have possible contamination. Results indicated elevated levels in some residents' home.



AR322612

EPA 096350

C. OBJECTIVE

The objective of this well water sampling plan is to characterize the presence or absence of contamination in residential wells around the Keystone Sanitation Landfill Site. TAT will be conducting the initial phase of the Remedial Investigation Program.

D. SCOPE

TAT plans to collect approximately 30 home well samples from residences surrounding the site, the list to be determined at a later date. The Environmental Response Team (ERT) standard operating procedures (SOP) #2007 and #2013 will be followed. Using known well data, where available, the amount of well water to be purged will be calculated so that three times the amount of water needed to fill the well casing (three well volumes) can be purged before the sample is taken. This purging will be done to obtain a representative sample from the groundwater supply. Where there is insufficient information to calculate three well volumes, the procedure will be to open the tap and let water flow until the well pump turns on, and continue for approximately ten minutes before collecting samples. All samples will be taken at a point as close as possible to the well through existing taps. Any deviation or special situation will be noted in the trip report. In order to assure proper quality assurance and quality control, TAT will also collect two duplicate samples, and prepare two field blanks and one trip blank. Each QA sample will be properly labeled. The associated sample glassware can be found in section (3)A of this document. All samples will be analyzed according to EPA Contract Laboratory Program (CLP) methodologies.

E. DATA USAGE

Data from this investigation will be used by EPA's Remedial Program to document the presence or absence of a threat or potential threat to the public welfare caused by the Keystone Sanitation Landfill Site.

F. MONITORING PARAMETERS AND FREQUENCY OF COLLECTION

MATRIX	PARAMETER
Water	Target Compound List (TCL) Organics
Water	Target Analyte List (TAL) Inorganics

(2) DATA QUALITY REQUIREMENTS AND ASSESSMENTS

Detection limits, quantitation limits, estimated accuracy, accuracy protocol, estimated precision, and precision protocol will all be maintained within the limits of the CLP test methods.

(3) **SAMPLING PROCEDURES**

A. Sampling Equipment:

1. 40-ml VOA vials
2. 1-liter amber glass bottles
3. 1-liter poly bottles
4. Chain-of-custody forms
5. Sample tags
6. Custody seals
7. CLP organic traffic reports
8. Latex gloves
9. 1-gallon plastic jug
10. Funnel
11. Hydrochloric acid
12. Nitric Acid (preservative)
13. Sodium Hydroxide (preservative)
14. Plastic sample shipping bags
15. Sample shipping cans
16. Stopwatch
17. Ice
18. pH paper
19. Trash bags
20. Sample coolers (as required)
21. Vermiculite

B. Decontamination of Sampling Equipment

Disposable latex gloves will be donned for each individual sample. Used disposable equipment will be double bagged and disposed of as dry industrial waste.

C. Sample handling and decontamination

Well water samples will be collected in 1-liter glass amber and/or poly sample containers and 40-ml volatile organic sample vials. Three (3) 40-ml VOA vials and six (6) each of 1-liter amber and (2) poly-bottle samples will be taken at each residence. In addition, two sites require double volume for laboratory QC. All exterior surfaces of sampling bottles will be rinsed with distilled water and dried. Volatile organic samples will be preserved with hydrochloric acid to a pH below 2.0. TAL Inorganic samples will be collected in 1-liter poly bottles and preserved with nitric acid to a pH below 2.0 (metals) or preserved with sodium hydroxide to a pH greater than 12.0 (cyanides).

The VOA samples will be placed in metal cans packed with vermiculite and ice and placed inside an insulated cooler. Chain-of-custody traffic report forms will be assigned per CLP requirements and affixed to the inside of the cooler lid. The cooler(s) will be bound with tape to prevent loss of the samples, then placarded and sealed with chain-of-custody seals. Coolers containing organic samples will be sent Federal Express to labs designated by CLP. [REDACTED] will be

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notified of quantity and date of shipment after sampling has been completed. The sample shipping log will be completed by TAT upon return to the Delran, New Jersey, office.

D. QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance and quality control protocols will follow CLP SOW's (3/90) for all samples.

ATTACHMENTS:

- (1) Residential Well Information Form
- (2) EPA Organic Traffic Report and Chain-of-Custody Record
- (3) Inorganic Traffic Report and Chain-of-Custody Record
- (4) Site Location Map
- (5) SOPs #2007 and #2013
- (6) TCL and TAL Parameter Lists

Sample # _____
(must appear on Custody & Sample L

FIELD DATA SHEET

ROY F. WESTON, INC.
TECHNICAL ASSISTANCE TEAM
EPA CONTRACT 68-WO-0036

Date: _____ Site Name: KEYSTONE SANITATION Chain of Custody No.: _____
Time: _____ Site Location: _____ EPA OSC: CHRIS CORBETT
Samplers: _____ Sample Location: _____ TDD No.: 9401-30

SITE DESCRIPTION			SOIL TYPE		SURFACEWATER		STREAM		GROUNDWATER	
landfill	field	upland palustrine	rock	clay	color	width			well depth	
industrial	wooded	lowland riverine	gravel	muck	odor	depth			depth to water	
commercial	farmland	lacustrine	sand	loam	flow	velocity			casing depth	
residential	floodplain	hedgerows	silt	peat	direction	pools			pretreatment	
			color			riffles			purging	

SAMPLE TYPE		SAMPLING DEVICE		WASTE CONTAINER TYPE		WEATHER PARAMETERS	
surface water	effluent	glass thief	bailler	drum	tankcar	wind conditions	
groundwater	sludge	bacon bomb	dredge	tank	vault	ambient temp	
oil/water	leachate	split spoon	auger	lagoon	waste pile	barometric pressure	
sediment	waste	disposable	trier	vat	other	relative humidity	
other	soil	other	trowel	transformer		weather conditions	

ANALYSIS TO BE PERFORMED (CHECK)

ORGANICS

- ☐ A. halogenated & aromatic volatiles
- ☐ B. volatiles
- ☐ C. trihalomethanes
- ☐ D. pesticides/PCB
- ☐ E. PCB
- ☐ F. base/neutral/acid extractables
- ☐ G. pesticides, drinking water
- ☐ H. herbicides, drinking water
- ☐ I. dioxin
- ☐ J. other _____
- ☐ K. TCL organics

INORGANICS

- ☐ A. metals, priority pollutant
- ☐ B. metals, TAL
- ☐ C. metals scan (ICP)
- ☐ D. metals, RCRA
- ☐ E. metals, other _____

RCRA

- ☐ A. TCLP
- ☐ B. ignitability
- ☐ C. corrosivity
- ☐ D. reactivity
- ☐ E. other _____

OTHER ANALYSIS

- ☐ A. total cyanide
- ☐ B. total phenol
- ☐ C. petroleum hydrocarbons
- ☐ D. pH
- ☐ E. alkalinity
- ☐ F. hardness
- ☐ G. total dissolved solids
- ☐ H. total suspended solids
- ☐ I. sulfate
- ☐ J. TOC
- ☐ K. grain size
- ☐ L. other _____

SAMPLE PREPARATION (CHECK)

CONTAINER

- ☐ amber glass jar
- ☐ clear glass jar
- ☐ poly jar/core
- ☐ acetate core
- ☐ VOA vial
- ☐ other _____

PRESERVATIVES

- ☐ none
- ☐ HNO₃
- ☐ NaOH
- ☐ Zn acetate
- ☐ Na₂SO₄

STORAGE

- ☐ cold packs
- ☐ dry ice
- ☐ wet ice
- ☐ ambient

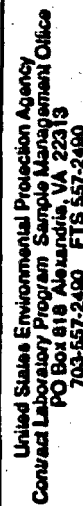
SCREENING DATA (CHECK IF DETECTED)

- | | |
|------------------------------------|---|
| <input type="checkbox"/> flammable | <input type="checkbox"/> explosive |
| <input type="checkbox"/> organics | <input type="checkbox"/> reactive |
| <input type="checkbox"/> radiation | <input type="checkbox"/> halogenated |
| <input type="checkbox"/> oxidizer | <input type="checkbox"/> PCB |
| <input type="checkbox"/> cyanide | <input type="checkbox"/> specific gravity |
| <input type="checkbox"/> pH | <input type="checkbox"/> other _____ |
| <input type="checkbox"/> HNu | <input type="checkbox"/> OVA |

COMMENTS/DIAGRAM:

EPA 096354

AR322616



Organic Traffic Report & Chain of Custody Record

(For Organic CLP Analysis)

United States Environmental Protection Agency
Contract Laboratory Program Sample Management Office
PO Box 818 Alexandria, VA 22313
703-557-2490 FTS 557-2490

[illegible]

CHAIN OF CUSTODY RECORD

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Date / Time	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Date / Time	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	is custody seal intact?	Y/N/none

EPA Form 110-2 (Rev. 5-91) Replaces EPA Form (2075-7), previous edition which may be used.

DUSTIN: N:
 Blue - Lab Copy Pink - SMO Copy White - Lab Copy for Return to Region Yellow - Lab Copy for Return to SMO

Split Samples ☐ Accepted ☐ (Signature)

☐ Declined☐ Declined

SEE REVERSE FOR ADDITIONAL STANDARD INSTRUCTIONS



United States Environmental Protection Agency
Contract Laboratory Program Sample Management Office
PO Box 618 Alexandria, VA 22313
703-557-2490 FTS 557-2490

Inorganic Traffic Report & Chain of Custody Record

(For Inorganic CLP Analysis)

Case No.

SAS No.
(if applicable)

1. Project Code		Account Code		2. Region No.		Sampling Co.		4. Date Shipped		Carrier		6. Preservative (Enter in Column D) 1. HCl 2. HNO3 3. NaOH 4. H2SO4 5. K2CrO7 6. Ice only 7. Other (Specify) N. Not preserved		7. Sample Description (Enter in Column A) 1. Surface Water 2. Ground Water 3. Leachate 4. Flimsie 5. Soil/Sediment 6. Oil (High only) 7. Waste (High only) 8. Other (Specify)									
Regional Information		Sampler (Name)		Sampler Signature		Airbill Number		5. Ship To		ATTN:													
Site Name		Site Spill ID		3. Type of Activity SF <input type="checkbox"/> Pre-Remediation PRP <input type="checkbox"/> PA <input type="checkbox"/> RA <input type="checkbox"/> O&M <input type="checkbox"/> NPLD <input type="checkbox"/> UST <input type="checkbox"/> ST <input type="checkbox"/> LSI <input type="checkbox"/> O&M <input type="checkbox"/> NPLD <input type="checkbox"/> UST <input type="checkbox"/> FED <input type="checkbox"/> LSI <input type="checkbox"/> O&M <input type="checkbox"/> NPLD <input type="checkbox"/> UST <input type="checkbox"/>		E - RAS Analysis Metal: <input type="checkbox"/> Low Conc. only <input type="checkbox"/> High only <input type="checkbox"/> Organic: <input type="checkbox"/> Low Conc. only <input type="checkbox"/> High only <input type="checkbox"/> pH: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		Regional Specific Tracking Number or Tag Numbers		F		G Station Location Number		H Mor/Day/Year/Time Sample Collection		I Sampler Initials		J Corresp. CLP Org. Samp. No.		K Enter Appropriate Qualifier for Designated Field QC B = Blank S = Spike D = Duplicate PE = Perform. Eval. -- = Not a QC Sample			
CLP Sample Numbers (from labels)		A Enter # from Box 7		B Conc. Sample Type: Low Med High		C Sample Type: Comp./Grab		D Preservative from Box 6		E - RAS Analysis		F		G Station Location Number		H Mor/Day/Year/Time Sample Collection		I Sampler Initials		J Corresp. CLP Org. Samp. No.		K Enter Appropriate Qualifier for Designated Field QC B = Blank S = Spike D = Duplicate PE = Perform. Eval. -- = Not a QC Sample	
Shipment for Case complete? (Y/N)		Page 1 of		Sample used for a spike and/or duplicate		Additional Sampler Signatures		Chain of Custody Seal Number															

CHAIN OF CUSTODY RECORD

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks Is custody seal intact? Y/N/none

Split Samples ☐ Accepted (Signature) ☐ Declined

EPA Form 9110-1 (Rev. 8-91) Replaces EPA Form (2075-8), previous edition which may be used

DISTRIBUTION:
Green - Region Copy Pink - SMO Copy White - Lab Copy for return to Region Yellow - Lab Copy for Return to SMO

SEE REVERSE FOR ADDITIONAL STAMPING INSTRUCTIONS

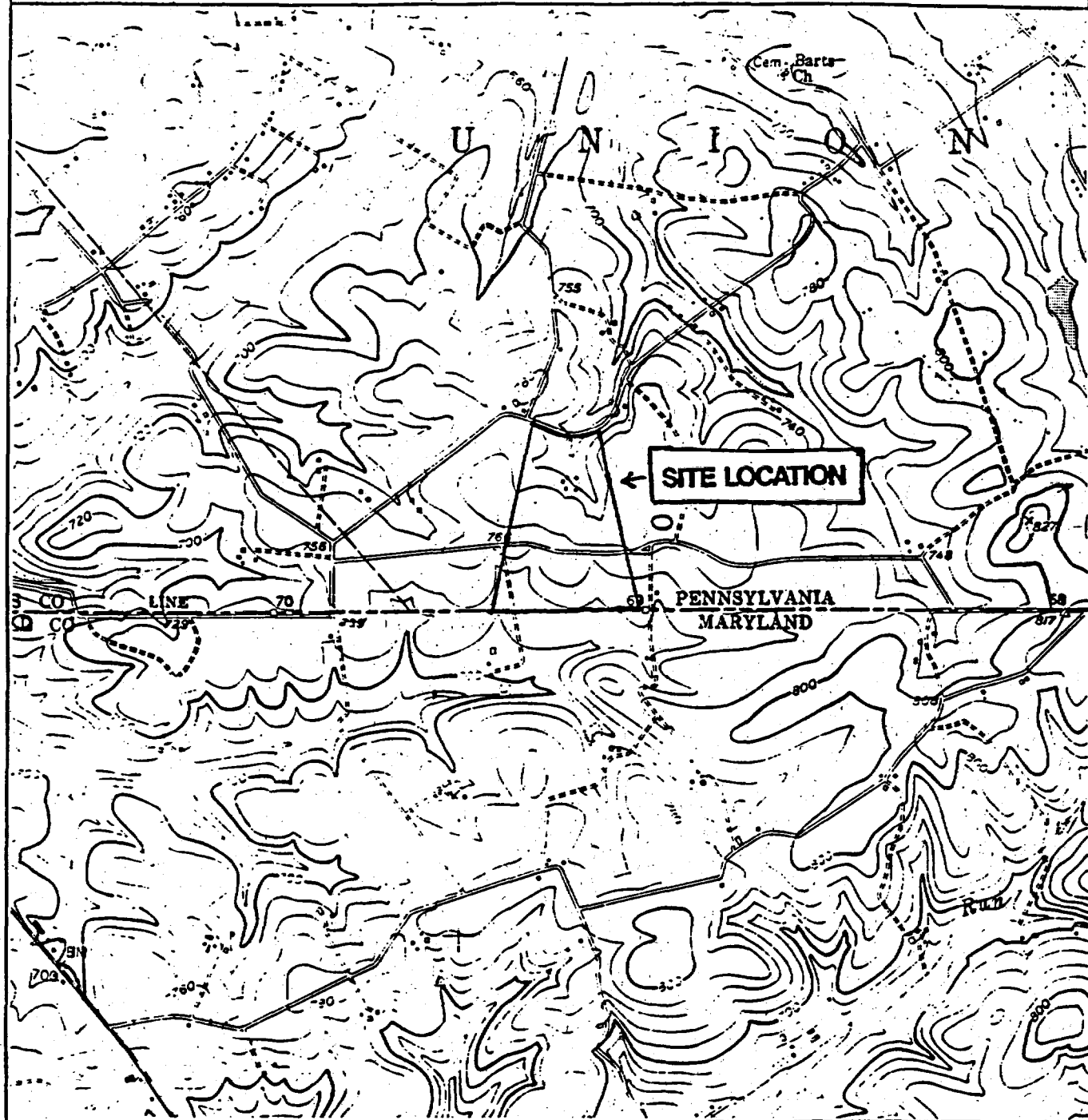


WESTON

MAJOR
PROGRAMS
DIVISION

TDD Number : 9308-29

PCS Number : 5020



SOURCE (7.5 MINUTE SERIES) U.S.G.S. LITTLETOWN, MD QUAD

SITE LOCATION MAP

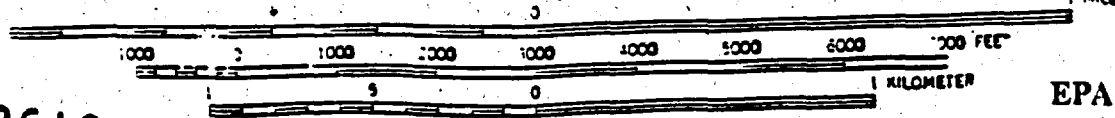
KEYSTONE SANITATION LANDFILL, HANOVER PA



QUADRANGLE LOCATION

1M GRID AND 1971 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

SCALE 1:24000



AR322619

EPA 096357

2.0 SURFACE WATER SAMPLING: SOP #2013

2.1 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) is applicable to the collection of representative liquid samples, both aqueous and nonaqueous from streams, rivers, lakes, ponds, lagoons, and surface impoundments. It includes samples collected from depth, as well as samples collected from the surface.

2.2 METHOD SUMMARY

Sampling situations vary widely and therefore no universal sampling procedure can be recommended.

However, sampling of both aqueous and non-aqueous liquids from the above mentioned sources is generally accomplished through the use of one of the following samplers or techniques:

- Kemmerer bottle
- bacon bomb sampler
- dip sampler
- direct method

These sampling techniques will allow for the collection of representative samples from the majority of surface waters and impoundments encountered.

2.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Once samples have been collected, follow these procedures:

1. Transfer the sample(s) into suitable labeled sample containers.
2. Preserve the sample if appropriate, or use pre-preserved sample bottles.
3. Cap the container, put it in a Ziploc plastic bag and place it on ice in a cooler.
4. Record all pertinent data in the site logbook and on a field data sheet.

5. Complete the chain of custody form.
6. Attach custody seals to the cooler prior to shipment.
7. Decontaminate all sampling equipment prior to the collection of additional samples.

2.4 INTERFERENCES AND POTENTIAL PROBLEMS

There are two primary interferences or potential problems with surface water sampling. These include cross-contamination of samples and improper sample collection.

- Cross-contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Refer to ERT SOP #2006, Sampling Equipment Decontamination.
- Improper sample collection can involve using contaminated equipment, disturbance of the stream or impoundment substrate, and sampling in an obviously disturbed area.

Following proper decontamination procedures and minimizing disturbance of the sample site will eliminate these problems.

2.5 EQUIPMENT/APPARATUS

Equipment needed for collection of surface water samples includes:

- Kemmerer bottles
- bacon bomb sampler
- dip sampler
- line and messengers
- sample bottle preservatives
- Ziploc bags
- ice
- cooler(s)
- chain of custody forms, field data sheets

1. Using a properly decontaminated Kemmerer bottle, set the sampling device so that the sampling end pieces are pulled away from the sampling tube, allowing the substance to be sampled to pass through this tube.
2. Lower the pre-set sampling device to the predetermined depth. Avoid bottom disturbance.
3. When the Kemmerer bottle is at the required depth, send down the messenger, closing the sampling device.
4. Retrieve the sampler and discharge the first 10 to 20 mL to clear any potential contamination on the valve. Transfer the sample to the appropriate sample container.

Bacon Bomb Sampler

A bacon bomb sampler (Figure 2, Appendix A) may be used in similar situations to those outlined for the Kemmerer bottle. Sampling procedures are as follows:

1. Lower the bacon bomb sampler carefully to the desired depth, allowing the line for the trigger to remain slack at all times. When the desired depth is reached, pull the trigger line until taut.
2. Release the trigger line and retrieve the sampler.
3. Transfer the sample to the appropriate sample container by pulling the trigger.

Dip Sampler

A dip sampler (Figure 3, Appendix A) is useful for situations where a sample is to be recovered from an outfall pipe or along a lagoon bank where direct access is limited. The long handle on such a device allows access from a discrete location. Sampling procedures are as follows:

1. Assemble the device in accordance with the manufacturer's instructions.
2. Extend the device to the sample location and collect the sample.
3. Retrieve the sampler and transfer the sample to the appropriate sample container.

Direct Method

For streams, rivers, lakes, and other surface waters, the direct method may be utilized to collect water samples from the surface. This method is not to be used for sampling lagoons or other impoundments where contact with contaminants are a concern.

Using adequate protective clothing, access the sampling station by appropriate means. For shallow stream stations, collect the sample under the water surface pointing the sample container upstream. The container must be upstream of the collector. Avoid disturbing the substrate. For lakes and other impoundments, collect the sample under the water surface avoiding surface debris and the boat wake.

When using the direct method, do not use pre-preserved sample bottles as the collection method may dilute the concentration of preservative necessary for proper sample preservation.

2.8 CALCULATIONS

This section is not applicable to this SOP.

2.9 QUALITY ASSURANCE/ QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures. However, the following general QA/QC procedures apply:

- All data must be documented on field data sheets or within site logbooks.
- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

2.10 DATA VALIDATION

This section is not applicable to this SOP.

2.0 GROUNDWATER WELL SAMPLING: SOP #2007

2.1 SCOPE AND APPLICATION

The objective of this Standard Operating Procedure (SOP) is to provide general reference information on sampling of groundwater wells. This guideline is primarily concerned with the collection of water samples from the saturated zone of the subsurface. Every effort must be made to ensure that the sample is representative of the particular zone of water being sampled. These procedures are designed to be used in conjunction with analyses for the most common types of groundwater contaminants (e.g., volatile and semi-volatile organic compounds, pesticides, metals, biological parameters).

2.2 METHOD SUMMARY

Prior to sampling a monitoring well, the well must be purged. This may be done with a number of instruments. The most common of these are the bailer, submersible pump, non-gas contact bladder pump and inertia pump. At a minimum, three well volumes should be purged, if possible. Equipment must be decontaminated prior to use and between wells. Once purging is completed and the correct laboratory-cleaned sample containers have been prepared, sampling may proceed. Sampling may be conducted with any of the above instruments, and need not be the same as the device used for purging. Care should be taken when choosing the sampling device as some will affect the integrity of the sample. Sampling equipment must also be decontaminated. Sampling should occur in a progression from the least to most contaminated well, if this information is known.

2.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The type of analysis for which a sample is being collected determines the type of bottle, preservative, holding time, and filtering requirements. Samples should be collected directly from the sampling device into appropriate laboratory-cleaned containers. Check that a Teflon liner is present in

the cap, if required. Attach a sample identification label. Complete a field data sheet, a chain of custody form and record all pertinent data in the site logbook.

Samples shall be appropriately preserved, labelled, logged, and placed in a cooler to be maintained at 4°C. Samples must be shipped well before the holding time is over and ideally should be shipped within 24 hours of sample collection. It is imperative that these samples be shipped or delivered daily to the analytical laboratory in order to maximize the time available for the laboratory to perform the analysis. The bottles should be shipped with adequate packing and cooling to ensure that they arrive intact.

Certain conditions may require special handling techniques. For example, treatment of a sample for volatile organic (VOA) analysis with sodium thiosulfate preservative is required if there is residual chlorine in the water (such as public water supply) that could cause free radical chlorination and change the identity of the original contaminants. However, sodium thiosulfate should not be used if chlorine is not present in the water. Special requirements must be determined prior to conducting fieldwork.

2.4 INTERFERENCES AND POTENTIAL PROBLEMS

2.4.1 General

The primary goal of groundwater sampling is to obtain a representative sample of the groundwater body. Analysis can be compromised by field personnel in two primary ways: (1) taking an unrepresentative sample, or (2) by incorrect handling of the sample. There are numerous ways of introducing foreign contaminants into a sample, and these must be avoided by following strict sampling procedures and only utilizing trained field personnel.

2.4.2 Purging

In a non-pumping well, there will be little or no vertical mixing of the water, and stratification will

**Table 2: Advantages and Disadvantages
of Various Groundwater Sampling Devices**

Device	Advantages	Disadvantages
Bailer	<ul style="list-style-type: none"> • The only practical limitations are size and materials • No power source needed • Portable • Inexpensive; it can be dedicated and hung in a well reducing the chances of cross-contamination • Minimal outgassing of volatile organics while sample is in bailer • Readily available • Removes stagnant water first • Rapid, simple method for removing small volumes of purge water 	<ul style="list-style-type: none"> • Time consuming, especially for large wells • Transfer of sample may cause aeration
Submersible Pump	<ul style="list-style-type: none"> • Portable; can be used on an unlimited number of wells • Relatively high pumping rate (dependent on depth and size of pump) • Generally very reliable; does not require priming 	<ul style="list-style-type: none"> • Potential for effects on analysis of trace organics • Heavy and cumbersome, particularly in deeper wells • Expensive • Power source needed • Susceptible to damage from silt or sediment • Impractical in low yielding or shallow wells
Non-Gas Contact Bladder Pump	<ul style="list-style-type: none"> • Maintains integrity of sample • Easy to use 	<ul style="list-style-type: none"> • Difficult to clean although dedicated tubing and bladder may be used • Only useful to approximately 100 feet in depth • Supply of gas for operation (bottled gas and/or compressor) is difficult to obtain and is cumbersome
Suction Pump	<ul style="list-style-type: none"> • Portable, inexpensive, and readily available 	<ul style="list-style-type: none"> • Only useful to approximately 25 feet or less in depth • Vacuum can cause loss of dissolved gases and volatile organics • Pump must be primed and vacuum is often difficult to maintain • May cause pH modification
Inertia Pump	<ul style="list-style-type: none"> • Portable, inexpensive, and readily available • Rapid method for purging relatively shallow wells 	<ul style="list-style-type: none"> • Only useful to approximately 70 feet or less in depth • May be time consuming to use • Labor intensive • WaTerra pump is only effective in 2-inch diameter wells

3. Remove locking well cap, note location, time of day, and date in field notebook or an appropriate log form.
4. Remove well casing cap.
5. Screen headspace of well with an appropriate monitoring instrument to determine the presence of volatile organic compounds and record in site logbook.
6. Lower water level measuring device or equivalent (i.e., permanently installed transducers or airline) into well until water surface is encountered.
7. Measure distance from water surface to reference measuring point on well casing or protective barrier post and record in site logbook. Alternatively, if there is no reference point, note that water level measurement is from top of steel casing, top of PVC riser pipe, from ground surface, or some other position on the well head.
8. Measure total depth of well (do this at least twice to confirm measurement) and record in site logbook or on log form.
9. Calculate the volume of water in the well and the volume to be purged using the calculations in Section 2.8.
10. Select the appropriate purging and sampling equipment.

2.7.3 Evacuation of Static Water (Purging)

The amount of flushing a well receives prior to sample collection depends on the intent of the monitoring program as well as the hydrogeologic conditions. Programs where overall quality determination of water resources are involved may require long pumping periods to obtain a sample that is representative of a large volume of that aquifer. The pumped volume can be determined prior to sampling so that the sample is a composite of known volume of the aquifer, or the well can be pumped until the stabilization of parameters such as temperature, electrical conductance, or pH has occurred.

However, monitoring for defining a contaminant plume requires a representative sample of a small volume of the aquifer. These circumstances require that the well be pumped enough to remove the stagnant water but not enough to induce flow from other areas. Generally, three well volumes are considered effective, or calculations can be made to determine, on the basis of the aquifer parameters and well dimensions, the appropriate volume to remove prior to sampling.

During purging, water level measurements may be taken regularly at 15- to 30-second intervals. This data may be used to compute aquifer transmissivity and other hydraulic characteristics.

The following well evacuation devices are most commonly used. Other evacuation devices are available, but have been omitted in this discussion due to their limited use.

Bailer

Bailers are the simplest purging device used and have many advantages. They generally consist of a rigid length of tube, usually with a ball check-valve at the bottom. A line is used to lower the bailer into the well and retrieve a volume of water. The three most common types of bailer are PVC, Teflon, and stainless steel.

This manual method of purging is best suited to shallow or narrow diameter wells. For deep, larger diameter wells which require evacuation of large volumes of water, other mechanical devices may be more appropriate.

Bailing equipment includes a clean decontaminated bailer, Teflon or nylon line, a sharp knife, and plastic sheeting.

1. Determine the volume of water to be purged as described in Section 2.7.2, Field Preparation.
2. Lay plastic sheeting around the well to prevent contamination of the bailer line with foreign materials.
3. Attach the line to the bailer and lower until the bailer is completely submerged.
4. Pull bailer out ensuring that the line either falls onto a clean area of plastic sheeting or never touches the ground.

pumps are made of plastic and may be either decontaminated or discarded, after use.

1. Determine the volume of water to be purged as described in Section 2.7.2, Field Preparation.
2. Lay plastic sheeting around the well to prevent contamination of pumps or hoses with foreign materials.
3. Assemble pump, and lower to the appropriate depth in the well.
4. Begin pumping manually, discharging water into a 5-gallon bucket (or other graduated vessel). Purge until specified volume of water has been evacuated (or until field parameters such as temperature, pH, conductivity, etc. have stabilized).
5. Collect and dispose of purge waters as specified in the site-specific project plan.

2.7.4 Sampling

Sample withdrawal methods require the use of pumps, compressed air, bailers, and samplers. Ideally, purging and sample withdrawal equipment should be completely inert, economical to use, easily cleaned, sterilized, reusable, able to operate at remote sites in the absence of power resources, and capable of delivering variable rates for sample collection.

There are several factors to take into consideration when choosing a sampling device. Care should be taken when reviewing the advantages or disadvantages of any one device. It may be appropriate to use a different device to sample than that which was used to purge. The most common example of this is the use of a submersible pump to purge and a bailer to sample.

Bailer

The positive-displacement volatile sampling bailer (by GPI) is perhaps the most appropriate for collection of water samples for volatile analysis. Other bailer types (messenger, bottom fill, etc.) are less desirable, but may be mandated by cost and site conditions. Generally, bailers can provide an acceptable sample, providing that sampling personnel use extra care in the collection process.

1. Surround the monitoring well with clean plastic sheeting.
2. Attach a line to the bailer. If a bailer was used for purging, the same bailer and line may be used for sampling.
3. Lower the bailer slowly and gently into the well, taking care not to shake the casing sides or to splash the bailer into the water. Stop lowering at a point adjacent to the screen.
4. Allow bailer to fill and then slowly and gently retrieve the bailer from the well, avoiding contact with the casing, so as not to knock flakes of rust or other foreign materials into the bailer.
5. Remove the cap from the sample container and place it on the plastic sheet or in a location where it will not become contaminated. See Section 2.7.7 for special considerations on VOA samples.
6. Begin pouring slowly from the bailer.
7. Filter and preserve samples as required by sampling plan.
8. Cap the sample container tightly and place pre-labeled sample container in a carrier.
9. Replace the well cap.
10. Log all samples in the site logbook and on field data sheets and label all samples.
11. Package samples and complete necessary paperwork.
12. Transport sample to decontamination zone to prepare it for transport to analytical laboratory.

Submersible Pump

Although it is recommended that samples not be collected with a submersible pump due to the reasons stated in Section 2.4, there are some situations where they may be used.

1. Allow the monitoring well to recharge after purging, keeping the pump just above the screened section.

3. Since these pumps are manually operated, the flow rate may be regulated by the sampler. The sample may be discharged from the pump outlet directly into the appropriate sample container.
4. Cap the sample container tightly and place pre-labeled sample container in a carrier.
5. Replace the well cap.
6. Log all samples in the site logbook and on field data sheets and label all samples.
7. Package samples and complete necessary paperwork.
8. Transport sample to decontamination zone for preparation for transport to analytical laboratory.
9. Upon completion, remove pump and decontaminate or discard, as appropriate.

2.7.5 Filtering

For samples that require filtering, such as samples which will be analyzed for total metals, the filter must be decontaminated prior to use and between uses. Filters work by two methods. A barrel filter such as the "Geotech" filter works with a bicycle pump, which is used to build up positive pressure in the chamber containing the sample. The sample is then forced through the filter paper (minimum size 0.45 μm) into a jar placed underneath. The barrel itself is filled manually from the bailer or directly via the hose of the sampling pump. The pressure must be maintained up to 30 psi by periodic pumping.

A vacuum type filter involves two chambers, the upper chamber contains the sample and a filter (minimum size 0.45 μm) divides the chambers. Using a hand pump or a Gilian type pump, air is withdrawn from the lower chamber, creating a vacuum and thus causing the sample to move through the filter into the lower chamber where it is drained into a sample jar, repeated pumping may be required to drain all the sample into the lower chamber. If preservation of the sample is necessary, this should be done after filtering.

2.7.6 Post Operation

After all samples are collected and preserved, the sampling equipment should be decontaminated prior to sampling another well. This will prevent cross-contamination of equipment and monitoring wells between locations.

1. Decontaminate all equipment.
2. Replace sampling equipment in storage containers.
3. Prepare and transport water samples to the laboratory. Check sample documentation and make sure samples are properly packed for shipment.

2.7.7 Special Considerations for VOA Sampling

The proper collection of a sample for volatile organics requires minimal disturbance of the sample to limit volatilization and therefore a loss of volatiles from the sample.

Sample retrieval systems suitable for the valid collection of volatile organic samples are: positive displacement bladder pumps, gear driven submersible pumps, syringe samplers and bailers (Barcelona, 1984; Nielsen, 1985). Field conditions and other constraints will limit the choice of appropriate systems. The focus of concern must be to provide a valid sample for analysis, one which has been subjected to the least amount of turbulence possible.

The following procedures should be followed:

1. Open the vial, set cap in a clean place, and collect the sample during the middle of the cycle. When collecting duplicates, collect both samples at the same time.
2. Fill the vial to just overflowing. Do not rinse the vial, nor excessively overfill it. There should be a convex meniscus on the top of the vial.
3. Check that the cap has not been contaminated (splashed) and carefully cap the vial. Place the cap directly over the top and screw down firmly. Do not overtighten and break the cap.

otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

2.10 DATA VALIDATION

This section is not applicable to this SOP.

2.11 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA and specific health and safety procedures. More specifically, depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling the first well. The site health and safety plan should be reviewed with specific emphasis placed on the protection program planned for the well sampling tasks. Standard safe operating practices should be followed such as minimizing contact with potential contaminants in both the vapor phase and liquid matrix through the use of respirators and disposable clothing.

For volatile organic contaminants:

- Avoid breathing constituents venting from the well.

- Pre-survey the well head-space with an FID/PID prior to sampling.
- If monitoring results indicate organic constituents, sampling activities may be conducted in Level C protection. At a minimum, skin protection will be afforded by disposable protective clothing.

Physical hazards associated with well sampling are:

- Lifting injuries associated with pump and bailer retrieval; moving equipment.
- Use of pocket knives for cutting discharge hose.
- Heat/cold stress as a result of exposure to extreme temperatures (may be heightened by protective clothing).
- Slip, trip, fall conditions as a result of pump discharge.
- Restricted mobility due to the wearing of protective clothing.

DATA SUMMARY FORM: BNA

NAME: _____
CASE # _____ SAMPLING DATES: _____

WATER SAMPLES (ug/L)

CRCL	COMPOUND	SAMPLE NO. DILUTION FACTOR	LOCATION						
10	PHENOL								
10	bis(2-CHLOROETHYL)ETHER								
10	2-CHLOROPHENOL								
10	*1,3 - DICHLOROBENZENE								
10	*1,4 - DICHLOROBENZENE								
10	1,2 - DICHLOROBENZENE								
10	2 - METHYLPHENOL								
10	bis(2 -CHLOROISOPROPY)ETHER								
10	4 - METHYLPHENOL								
10	N-NITROSO-DI-N-PROYLEHINE								
10	HEXACHLOROETHANE								
10	NITROBENZENE								
10	ISOPHORONE								
10	NITROPHENOL								
10	2,4 - NIMETHYLPHENOL								
10	bis(2 -CHLOROETHOXY)METHANE								
10	2, 4 DICHLOROPHENOL								
10	1,2,4 - TRICHLOROBENZENE								
10	NAPHTHALENE								
10	4 - CHLOROANILINE								

CRCL = CONTRACT REQUIRED QUANTITATION LIMIT

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DATA SUMMARY FORM: VOLATILES

NAME: _____ CASE # _____ SAMPLING DATES: _____

CRQL	COMPOUND	SAMPLE NO. DILUTION FACTOR	LOCATION						
10	CHLOROMETHANE								
10	BROMOMETHANE								
10	*VINYL CHLORIDE								
10	CHLOROETHANE								
10	*ETHYLENE CHLORIDE								
10	ACETONE								
10	CARBON DISULFIDE								
10	*1,1 - DICHLOROETHENE								
10	1,1 - DICHLOROETHANE								
10	*TOTAL 1,2 DICHLOROETHENE								
10	CHLOROFORM								
10	*1,2 - DICHLOROETHANE								
10	*2 - BUTANONE								
10	*1,1,1 - TRICHLOROETHANE								
10	*CARBON TETRACHLORIDE								
10	VINYL ACETATE								
10	BROMODICHLOROETHANE								

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DATA SUMMARY FORM: INORGANICS

NAME: _____
CASE # _____
SAMPLING DATES: _____

SAMPLE NO. DILUTION FACTOR		LOCATION	CONC.	UNIT	REMARKS
200	ALUMINUM				
60	ANTIMONY				
10	*ARSENIC				
200	BARIUM				
5	BERYLLIUM				
5	*CADMIUM				
5,000	CALCIUM				
10	*CHROMIUM				
50	COBALT				
25	COPPER				
100	IRON				
3	*LEAD				
5,000	MAGNESIUM				
15	MANGANESE				
0.2	MERCURY				
40	*NICKEL				
5,000	POTASSIUM				
5	SELENIUM				
10	SILVER				
5,000	SODIUM				
10	THALLIUM				
50	VANADIUM				

DATA SUMMARY FORM: PESTICIDES/PCB'S

NAME: _____
CASE # _____
SAMPLING DATES: _____

SAMPLE NO. DILUTION FACTOR		LOCATION	CRQL	COMPOUND																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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2.0	*AROCIER-1221					
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1.0	*AROCIER-1242					
1.0	*AROCIER-1248					
1.0	AROCIER-1254					
1.0	AROCIER-1260					

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